

Research Article

Effect of MIIT training on visfatin and insulin resistance index in obese girls

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Abstract

Background: Visfatin is an adipocytokine new adipocyte which is highly expressed in visceral adipose tissue and has similar effects with insulin. As obesity is a worldwide health issue and visfatin is associated in obesity and insulin resistance. The purpose of this study was to investigate the effect of moderate intensity interval training on visfatin and insulin resistance index in obese girls.

Materials and Methods: In this semi-experimental study, 18 obese girls aged 12-14 years old were selected according to inclusion and exclusion criteria and randomly divided into training (n=10) and control (n=8) groups. The training program lasted eight weeks, three times weekly for 30 minutes each session, running at 70% of the target heart rate for the first 4-week and 75% for the rest of the protocol. Blood samples were taken for measuring visfatin, insulin, and glucose 24 hours before and 48 hours after the last session. Insulin resistance, visfatin, glucose, Vo₂max, fat percent, BMI, and body weight were measured using specific methods. Analysis of covariance ANCOVA was used. The significance level was considered as $p < 0.05$.

Results: The results of the current paper showed that visfatin, Insulin resistance index, insulin and maximal oxygen consumption (vo₂max) were increased in the experimental group, which was significant only for the values of vo₂max ($P = 0.001$). Body weight, body fat percentage, body mass index or BMI and glucose significantly decreased in the experimental group.


Conclusion: Today obesity is a worldwide health issue and in this paper we showed that long training sessions with adequate intensity and volume have beneficial effects on health issues and they are suggested to make optimal changes in visfatin levels and reduce insulin resistance in obese girls.

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1. Introduction

Obesity as a pervasive inflammatory disease is associated with an increased incidence of mortality. Obesity is a multifactorial problem caused by energy imbalance and today the main reason is reduced physical activity (1). Adipose tissue is an active endocrine and paracrine gland with the synthesis and secretion of a set of adipocytokines and hormones such as visfatin, adiponectin, leptin, and resistin. It has priceless effects in cholesterol metabolism, immune function, energy expenditure regulation, insulin function and nutrition (2). Visfatin is a new adipocytokine that is mainly secreted by visceral adipose tissue, but its production is also seen in skeletal muscle, liver, bone marrow, and lymphocytes. It binds to the insulin receptor at a site other than the insulin binding site, without altering or competing with insulin, and acts synergistically with insulin, stimulating glucose uptake into adipose tissue cells and myocytes and preventing the release of glucose from liver (3). Lopez et al Reported a positive relationship between pancreatic beta cell degradation and increased plasma concentrations of visfatin and stated that visfatin is related with Insulin resistance (4). Insulin resistance is a compensatory response by pancreatic beta cells to a decrease in the sensitivity of target tissues (liver, fat, and muscle tissue) to the metabolic effects of insulin and is part of a sequence of disorders often referred to as metabolic syndrome (5). In general, long-term training by increasing glucose carriers (GLUT4), insulin receptor substrates, and muscle mass, increases the body's response to insulin and increases insulin sensitivity, and in the prevention of obesity and its subsequent side effects are effective (6).

Nexi et al showed that 12 weeks of regular endurance training improved insulin resistance (7). In a study, Dangil et al studied the effect of combined training on visfatin and metabolic syndrome factors in obese women and observed a significant decrease in visfatin, fat percentage and fasting glucose level (8). However, Taghian et al did not observe a significant change in serum visfatin levels after 12 weeks of aerobic training in obese women (9). Considering the relationship between the onset of obesity in adolescence and youth with its occurrence in adulthood and the existence of contradictory findings on the effect of training on visfatin and insulin resistance index in previous studies and the lack of application of moderate intensity interval training (MIIT), the researcher intends to investigate the effect of moderate intensity interval training on visfatin and insulin resistance index in obese girls.

2. Materials and Methods

Subjects

The present study was a quasi-experimental study with pre-test and post-test designs. The statistical population of the present study was 40 obese girls aged 12-14 years in one of the junior high schools.

Eighteen calculated the sample size based on Cohen's table (10) (average height 157.4 cm and weight 78.5 kg) were selected voluntarily and purposefully, then randomly in 2 experimental groups (n=10) and control (n=8) were located. Criteria for inclusion of subjects in the research protocol according to the approval of the relevant physician include having physical health, no cardiovascular disease, diabetes, hypertension, menstrual disorders and other diseases, as well as not taking drugs, supplements, cigarettes and alcohol and not participating in training program at least 3 months before participating in this study training protocol. Necessary information about the nature and manner of conducting the research, possible risks and necessary points to participate in the research were given to them orally and written consent was obtained from them and their families. Subjects were allowed to enter the protocol after performing the necessary examinations by a general physician.

Full observance of ethical considerations (confidentiality of the subjects' information, full discretion of the subjects to leave the study at any stage) was performed. The height of the subjects was evaluated using the Seca gauge model 213 made in Germany with an accuracy of 1 mm and the weight and body fat percentage of the subjects were evaluated using the body composition device (Body composition Beurer) model BF66 made in Germany.

Before and after the research protocol, the subjects were placed on the device in thin sports clothes, without shoes, and after entering characteristics such as height, age and sex, they were immobile for a few seconds, then the amount of weight and body fat percentage on the form was registered. Subjects' body mass index was calculated by dividing weight by height squared and evaluated according to the BMI table of adolescents (Plumen 2011): $\text{body weight (kg)} / \text{height squared (m)} = \text{BMI (11)}$.

Exercise protocol

Intensity of the training

To determine the intensity of training based on the target heart rate, the following 3 steps were performed:

Calculation of maximum heart rate using Karvonen method as follow:

1. $220 - \text{subject age} = \text{maximum heart rate}$
2. $\text{Maximum heart rate (MHR)} - \text{Resting heart rate (R HR)} = \text{Reserve heart rate (HRR)}$
3. $\text{Resting heart rate} + (\text{percentage of determined intensity} \times \text{reserve heart rate}) = \text{target heart rate (12)}$.

At the end of the first 4 weeks, the subjects' resting heart rate was recalculated and the training program of the second 4 weeks was planned based on the adapted heart rate of the first 4 weeks. Heart rate control during training was performed by a Polar 400m pulse meter made in Germany.

Measurement of maximum oxygen consumption (vo2max)

Maximum oxygen consumption was assessed using the one mile running and walking test (Coverton 8-17 years). The calculation method was that the subjects ran 1 mile (1609/350m) in the gym around the handball field (about 14 laps) and at the end, the running time was recorded in the record sheet and according to the formula below, the value of vo2max was calculated (13).

$$\text{VO2Max} = 1.476 - 0.199 (\text{time, minute}) + 0.34 (\text{time, minute}) + 0.21(\text{age} \times \text{sex}) - 0.84(\text{BMI})$$

(Gender: 1 for men, zero for women)

The experimental group performed their training program under the supervision of a researcher in the Imam gym located in the Imam school of Pakdasht city on January and February, 2018. Subjects trained for 8 weeks, 3 sessions per week for 30 minutes each session week. Each workout included 10 minutes of warm-up and 5 minutes of cool down. Subjects ran for 30 seconds at 70% of the target heart rate in the first to fourth weeks, followed by active rest for 30 seconds at 50% of the target heart rate. They did this exercise 6 times in the same way. Then they had 4 minutes of inactive rest and the exercise was repeated 6 times. In the fifth to eighth week, repetitions were 8 times and the intensity of training was 75% of the target heart rate (Table 1) (14).

Table 1: MIIT training protocol

Training	The first to fourth week	Fifth to eighth week
MIIT	2 repetitions (Active rest S30, running S 30) repeat for 6 times 50% - 70%: Training intensity Rest: 4 min	2 repetitions (Active rest S30, running S 30) repeat for 8 times 50% - 75%: Training intensity Rest: 4 min

To evaluate biochemical variables, in two stages (24 hours before the start of training and 48 hours after the last training session) after 12-14 hours of fasting, the amount of 7 cc of blood from the vein of the left hand of each subject in a sitting position in the morning was taken by the laboratory expert of Zaeem Hospital. Blood samples were centrifuged (Hetich made in Germany) for plasma separation for 15 minutes at 3000 rpm and kept at -20 ° C for subsequent analysis.

Visfatin concentration was measured by ELISA method and Biosy kit made in China with sensitivity of 0.25 ng / ml. Insulin levels were measured by Liason device using quantitative luminance method using DiaSorin kit made in Italy. Glucose values was measured by enzymatic colorimetric method (Hitachi 911 device) and photometric kit of Pars Azmoon Company made in Iran. Insulin resistance was calculated using HOMA-IR equation (15).

$$\text{HOMA-IR: } \left[\left(\frac{\mu\text{g/ml}}{\text{Mmol/L}} \right) \text{ Fasting insulin} \times \text{Fasting glucose} \right] \div 22.5$$

Statistical Analysis

Shapiro-Wilk test was used to determine the normality of data distribution and ANCOVA analysis of covariance was used to determine the significance of the difference between the group and within the group. To analyze the research data, SPSS software version 24 was used and a significance level of $p < 0.05$ was considered.

3. Results

Body weight, fat percentage, maximum oxygen consumption (vo2max), body mass index (BMI), visfatin, insulin resistance index, insulin and glucose in experimental and control groups, before and after eight weeks of training were provided in Table 2. The results presented in Table 2 show that visfatin, insulin resistance index, insulin and maximum oxygen consumption (vo2max) of the experimental group increased after 8 weeks of training, which was only significant for vo2max values ($P = 0.001$). Also, the variables of weight, body fat percentage, BMI and glucose decreased in the experimental group, which was not significant.

Table 2: Variables of the two groups as mean \pm standard deviation in the Pre-test And after eight weeks of training

Research groups		control group	Training group	P value
Variable				
visfatin (Ng / ml)	Pre-test	17/5 \pm 4/3	15/8 \pm 4/2	.1685
	Post-test	17/8 \pm 5/4	17/6 \pm 4/8	
Insulin (Miu /ml)	Pre-test	26/7 \pm 8/4	23/7 \pm 8/3	.1881
	Post-test	27/0 \pm 10/8	25/1 \pm 9/4	
Insulin resistance index HOMA-IR	Pre-test	6/7 \pm 2/3	5/8 \pm 2/2	.1819
	Post-test	6/7 \pm 2/9	6/1 \pm 2/8	
Glucose (Mg/dl)	Pre-test	5/6 \pm 0/3	5/5 \pm 0/5	.1613
	Post-test	5/5 \pm 0/3	5/4 \pm 0/4	
VO_{2max} (MI / kg / min)	Pre-test	26/9 \pm 1/3	25/9 \pm 1/5	* .001
	Post-test	27/1 \pm 2/1	29/7 \pm 2/1	
Fat Percentage (Percent)	Pre-test	26/7 \pm 2/4	29/5 \pm 2/0	.1461
	Post-test	27/0 \pm 2/1	29/2 \pm 2/3	
BMI (Kg /m ²)	Pre-test	29/8 \pm 3/2	23/5 \pm 3/5	.1076
	Post-test	30/5 \pm 3/1	23/2 \pm 3/8	
Body weight (kg)	Pre-test	74/8 \pm 10/9	82/5 \pm 10/4	.1084
	Post-test	76/6 \pm 10/7	81/7 \pm 10/6	

ANCOVA analysis of covariance

Meaningful * $p < 0.05$

4. Discussion

Aerobic training increases the use of body fat reserves and is the best way to reduce fat tissue and total body weight. Due to aerobic training, the ability to harvest and oxidize fat in trained muscles increases. In these training, by increasing the activity of lipoprotein lipase, the beta oxidation capacity of fat in muscle increases and its important effect is to increase the share of fat and thus a proportional decrease in the share of glucose in energy production in aerobic training (14). The first result of the present study showed that 8 weeks of MIIT training increased visfatin in the experimental group. In expressing the possible causes of visfatin increase, we can mention a slight weight loss and body fat percentage of the subjects. Studies have shown that exercise-induced decrease in plasma visfatin is due to weight loss and changes in body composition of obese and overweight people (9). Visfatin is also produced from sources other than visceral adipose tissue (9).

Therefore, it is possible that MIIT training affected those tissues and increased the secretion of visfatin, in other words, the MIIT training method failed to provide the necessary stimuli to reduce serum visfatin from other sources. The results of Shaykh al-Islami Watani's research are in line with the results of the present study. They concluded that examining the effect of resistance training on 15 young men, increase in inflammation due to acute resistance training as well as fasting of the subjects led to an increase in visfatin (16).

Another possible reason for the increase in visfatin is the high insulin level of the subjects.

Haider et al. (2006) showed that visfatin is increased in people with hyperglycemic, diabetic and obese conditions and plays a pivotal role in insulin resistance due to obesity (17).

The researchers said that continuous stimulation of the insulin receptor by increasing plasma glucose levels due to diabetes may have an adverse effect on insulin sensitivity and a decrease in visfatin concentration. Exercise training can possibly reduce serum gene expression and serum visfatin levels due to its effects on reducing visceral adipose tissue and thus improving some adipokines. Rostami et al (2010) showed that 8 weeks of resistance and endurance training reduced visfatin (18).

They stated that a decrease in visfatin followed a decrease in body fat percentage and triglyceride levels (19). Saqibjoo et al (2012) investigated the effect of 8 weeks of resistance and aerobic training on visfatin levels in obese women. In this study, the level of visfatin decreased in both training groups but was significant in the resistance training group. The researchers attributed this to the greater effect of resistance training on visceral fat (19).

Erdem et al (2008) also reported that a six-week lifestyle modification program, including diet modification and 30 minutes of daily aerobic exercise in patients with metabolic syndrome, significantly reduced visfatin levels. The researchers reported that a decrease in visfatin was associated with improved body composition and insulin resistance index (20).

Results of the present study with Malik et al (2017) who examined the effect of intense training and carbohydrate supplementation on visfatin in sprinters and also with a study by Suri et al (2015) that examined the effect of continuous and interval aerobic training on visfatin levels in obese diabetic women is inconsistent (21-22). It is possible that the discrepancies between these studies and the results of the present study are due to differences in the type and intensity of training, decreased or increased blood sugar and insulin, weight changes, changes in body composition, carbohydrate supplementation and calorie restriction.

Another result of the present study showed that eight weeks of MIIT training increased insulin and insulin resistance index. Insulin resistance is a biological response to the concentration of insulin in the body (16). Research shows that endurance training improves insulin sensitivity, increases muscle contractions and muscle mass, improves glucose-to-muscle cell transport, and insulin sensitivity by increasing levels of muscle GLUT4, insulin receptors, protein kinase B, and glycogen synthase (16). GLUT4 is the most important isoform in skeletal muscle that its activity is affected by muscle contraction and insulin (17).

Exercise training increases the amount of GLUT4 in trained muscles, which improves insulin action on glucose metabolism. When blood insulin secretion decreases, basal insulin levels and glucose-stimulated insulin levels decrease, resulting in decreased insulin resistance in tissues (7).

The results of the present study are consistent with the research of Tahmasebi (2012) and Shaykh al-Islami (2014) who found in their research that exercise increases insulin and insulin resistance index (16, 23). Tahmasebi et al. reported that one session of acute circular resistance training increased insulin resistance in healthy men due to increased production of inflammatory markers interleukin-6 and interleukin-10 (23). However, Taghian et al (2013) reported a decrease in insulin resistance in obese subjects due to change in the volume of visceral fat (9). Improving insulin resistance after exercise training is closely related to reducing body fat mass (24). Rostami et al (2015) reported a decrease in insulin resistance in women by using eight weeks of combined training. The researchers said that weight loss, body mass index and fat percentage, along with other physiological effects of physical activity on insulin and carbohydrate metabolism, were effective in reducing insulin resistance (24). Therefore, the slight weight loss and body fat percentage of the subjects in the present study may be the reason for this result. Souri et al (2015) also showed that 10 weeks of resistance training has no significant effect on insulin resistance index. They acknowledged that the intensity of the exercises applied was not sufficient to affect insulin resistance in these individuals (22). Other results showed that blood glucose decreased but was not significant after 8 weeks of MIIT training. One of the possible reasons for the lack of significant reduction in this variable was a slight decrease in body fat percentage and moderate intensity of training. As Suri et al. reported that the reason for not changing glucose after resistance training was the lack of change in weight and body fat percentage of the subjects (22).

Tashakkorizadeh et al (2013) stated, the reason for the significant decrease in blood glucose was a relatively long time and optimal intensity of training (25). Khajeh Landi et al (2017) stated that the reason for the decrease in glucose was the consumption of aloe vera extract along with swimming training. These researchers stated that aloe vera extract reduces blood glucose (26). According to the results of the present study on the effect of aerobic training on a significant increase in maximal oxygen consumption, it can be acknowledged that aerobic training has an important role in aerobic fitness.

Bahram et al (2013) reported that the reason for the increase in maximal oxygen consumption was an increase in muscle oxidative capacity and an increase in blood hemoglobin (27). Fayyazi et al (2013) also stated that the reason for increasing the maximum oxygen consumption is improving the function of the respiratory muscle (28). Among the limitations of this study, we can point to the different adaptation responses of individuals to sports activities, individual differences and different diets.

Conclusion

Because obese people are exposed to various diseases; And these diseases are often due to reduced physical activity due to overweight and stiffness to withstand exercise pressure, the need for an exercise protocol that puts less pressure on these types of people is essential; It seems that MIIT training can be used as a suitable option. However, in order to make optimal changes in visfatin levels and reduce insulin resistance, longer training sessions and sufficient intensity training may be necessary. Given that the response to training is an age and sex-related phenomenon; comparing the effect of training at different ages of men and women in future studies to determine the effect of age and sex on these indicators can have significant results.

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Compliance with ethical standards

Conflict of interest The authors declare that there is no conflict of interest

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Author contributions

Conceptualization: H.S., S.R.; Methodology: H.S., S.R.; Software: H.S., S.R., R.M.; Validation: S.R., D.R.B.; Formal analysis: S.R., D.R.B., R.M.; Investigation: H.S., S.R., D.R.B.; Resources: S.R.; Data curation: S.R., R.M.; Writing - original draft: H.S., S.R.; Writing - review & editing: S.R., D.R.B., R.M.; Visualization: S.R.; Supervision: S.R.; Project administration: H.S.; Funding acquisition: H.S., R.M.

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